KSCST SYNOPSIS

1. **Project Proposal Reference No. :** 46S_BE_0341
2. **Title of the Project:** Bioelectricity Generation from Sewage Water.
3. **Name of the College:** Bangalore Institute of Technology
4. **Department:** Electronics and Telecommunication Engineering
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7. **Keywords:** Renewable resource, bio-electricity, cost-efficient.
8. **Introduction:** A Microbial fuel cell (MFC) is a bio-electrochemical device based on the interaction of microorganisms and electrodes that provide a great opportunity to treat wastewater while simultaneously generating electricity, serving as an alternative source of power generation. In an MFC, the generation of power takes place by converting a part of the chemical energy contained in the biodegradable substrates into electrical energy through the metabolic activity of bacteria. This is both economically and environmentally effective when the organic matter has no intrinsic value, as in domestic and industrial wastewater. Hence MFCs hold great promise towards sustainable power generation and are quite eco-friendly in nature as they significantly reduce the amount of waste entering various water bodies through the wastewater treatment that occurs. Global energy demand is increasing almost daily, resulting in energy crises and environmental pollution. Energy from fossil fuels remains non-sustainable owing to their limited, exhausting supplies and their environmental impact. Hence there has risen a need for alternate energy sources which are eco-friendly and sustainable. A Microbial fuel cell (MFC) works on the principle of converting chemical energy from microbes into electrical energy. The entire process is mediated through microbial catalytic reactions. Although the initial power generation efficiency of MFCs is low, several recent alterations to the design, parts, and overall process have resulted in enhanced power output.

9. **Objectives:** The main objective of power generation using sewage water is to develop an efficient system where power can be generated sustainably and also the sewage water is treated before it is let into river bodies. This technology uses microorganisms to convert chemical energy into electrical energy to generate electricity. Microbial Fuel Cell (MFC) generate power and treat wastewater by harnessing the oxidizing potential of anaerobic bacteria and the conduction of electrons through an external circuit. This project mainly focusses on using domestic sewage. More practical research focuses on the use of practical wastewater such as food processing waste, municipal wastewater, and agricultural wastewater. Similar type of fuel cell could also be built for bio-medical waste, and industrial effluents.

10. **Methodology:** Microbial Fuel Cell technology is used to convert chemical energy to electrical energy from organic wastes or carbon sources, which is carried out by an oxidation process and electrochemically active bacteria. The working is based on the principle of redox reactions. The anaerobic bacteria oxidize the organic matter to produce carbon dioxide (CO_2), electrons, and protons. The natural metabolism of the microbes is utilized to generate electricity. The substrates are converted into electrons by bacteria.

    In the single-chamber MFC design as shown in Figure 1, the cathode chamber, catholyte, and PEM are removed, and one side of the cathode is directly exposed to oxidants, usually to the atmosphere (air cathode) and the other side to the anolyte. The air cathode allows oxygen (O_2) in the air to react with protons (H^+) to form water (H_2O) at the cathode surface. In this project, the current generated from the Microbial fuel cell is given to the Voltage amplifier- AD620. This output is given to either LED i.e. the streetlights or to the power storage system developed which stores the voltage. In order to monitor the current generated, a voltage meter and current sensor are interfaced with an Arduino UNO, and parameters are monitored in real-time using a software application, Blynk.

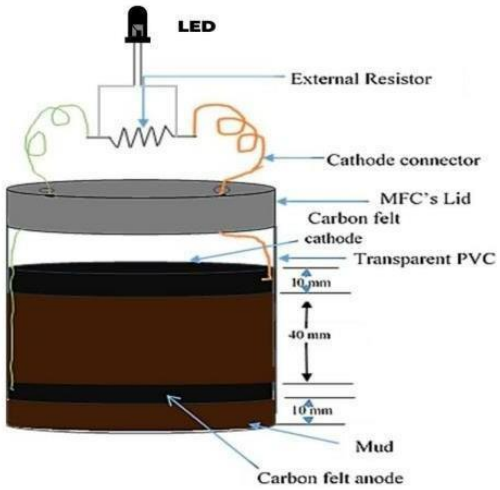

Figure 1. Microbial Fuel Cell

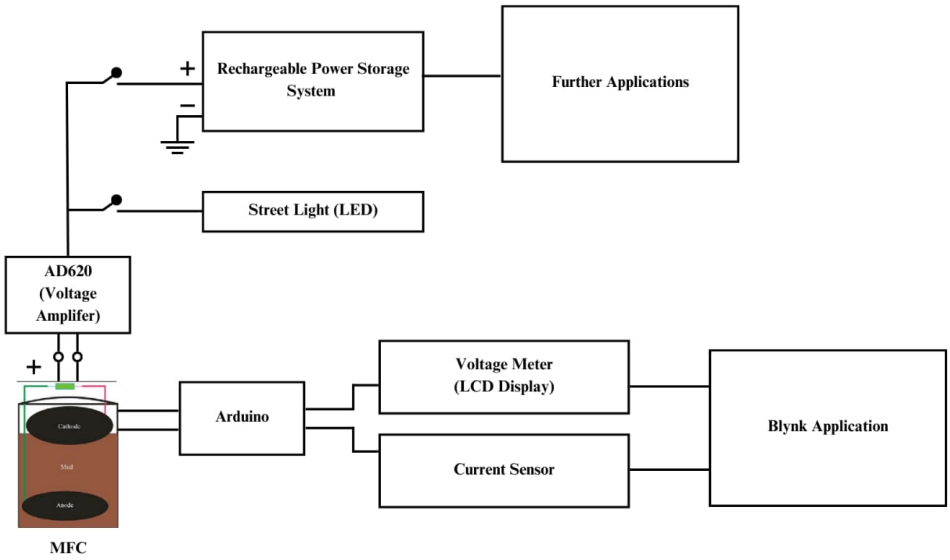

Figure 2. Project Block Diagram

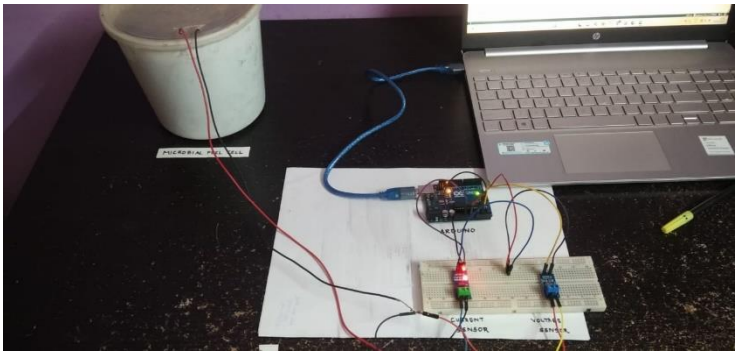

Figure 3. Project Model

11. **Results and Conclusion:** The proposed model is developed successfully and it produced expected voltage with respect to size of MFC, as shown in Table 1. For two variable quantities of sludge the electricity was measured, the Voltage measured is the amplified voltage and it is stored in a Power storage system, which could be used for various applications in real-time. The developed model acts as a Bio-fuel which is Eco-friendly, renewable and an economical replacement for Conventional fuels.

Table 1. Obtained Results

Quantity of Sludge in MFC	Carbon quantity	Voltage measured
300g	20g	5.18V
2300g	50g	10V

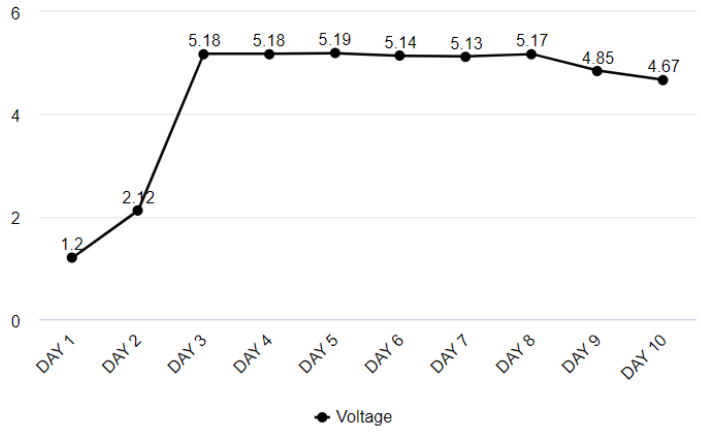

Figure 4. Voltage Values

The output voltage from MFC was monitored for a period of 10 days as shown in Figure 4. It was observed that on Day-5, the MFC worked at its maximum efficiency, also this voltage was sustained upto Day-8 after which there were slight fluctuations. It was observed that with an increase in sludge quantity, the output voltage increased from about 5V to 10V and this could be used for various other applications. MFC is expected to sustain the voltage value for upto 15 days, which can be enhanced by changing the water/sludge and using catalysts.

12. **Scope for Future Work:** A microbial fuel cell includes an anode and a cathode in two compartment or one compartment. The wastewater flows to the anode through the wastewater inlet and oxygen and electron acceptor flows to the cathode through electron receptor. Pollutant degrading microorganisms will be present in contact with the anode. The two electrodes anode and cathode are connected through an external circuit. The fed waste water coming out from the MFCs after the process of power generation is treated water / water with less toxic and can be reused. Further, the current being generated can be used for charging mobile.

    The MFC technology is still not commercialized despite of 10 years of intensive research on the MFC studies. There is yet to solve many problems in the technology to launch the MFCs in the real-world applications. The main drawback of the MFC is the insufficient power output. The other limitations are related to the high cost of the electrode materials, membranes, and the cathode catalyst hence in this model we have used activated carbon as the electron acceptor. The power output in MFCs can be improved in the future by providing electrode materials of high surface area, while the absence of PEM in futuristic MFC (at large scale) can make the MFC more economical. The MFCs used for wastewater treatment still need effective amendment to completely purify the water.